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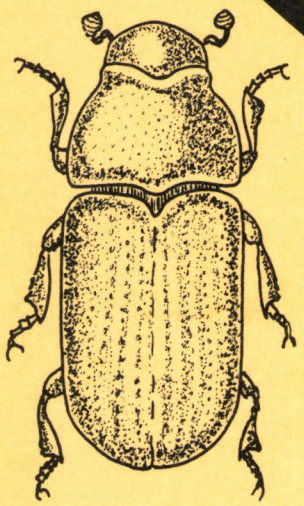

Southwestern Region

U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

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BIOLOGICAL EVALUATION
Spruce Beetle

Fort Apache Indian
Reservation
Arizona

1974

Branch of Forest Insect and Disease Management
Division of Timber Management
Southwestern Region, USDA, Forest Service
517 Gold Avenue, SW
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ABSTRACT

The spruce beetle infestation on the Fort Apache Indian Reservation, Arizona, continued the downward trend initiated by extreme cold early in 1971. During 1973, 12,600 standing Engelmann spruce trees were infested on 18,360 acres surveyed. Most (62.8%) of the standing tree losses were in Bonito Creek drainage. About 7,000 green windthrown spruce trees were also found during the survey. Sixty-eight percent of these were infested. With the possible exception of Bonito Creek, the infestation has reached an endemic level.

INTRODUCTION

For the past 4 years, an infestation of the spruce beetle, Dendroctonus rufipennis (Kirby), has existed in the White Mountains of east central Arizona (3, 4, 5). The infestation has occurred throughout the largest continuous forest of Engelmann spruce, Picea engelmannii Parry, in Arizona. This forest covers about 45,000 acres above 9,000 feet. Most of the forest (40,000 acres) is on the Fort Apache Indian Reservation, with the remainder in the Mt. Baldy Wilderness of the Apache National Forest.

This report evaluates current tree losses from the spruce beetle infestation based on 1973 survey data. Engelmann spruce losses from beetle attack and from windthrow were obtained in five drainages: Becker, Bonito, Ord, Smith, and Paradise Creeks. Observations made in Ord Creek, by Region 3 Forest Service entomologists during May 1973, revealed some of the trees killed in 1972 had been partially infested in 1971. Other living trees were only partially attacked in 1972. This attack pattern is common during declining spruce beetle infestations (9), and is characteristic of endemic populations (8). To determine the current extent of this attack pattern for the present infestation, partial attacks which occurred during 1973 were counted. The incidence of infested windthrow was also determined, since populations in windthrow help maintain endemic infestations (8) and may contribute significantly to epidemics.

The spruce beetle infestation trend was not evaluated since the present sampling plan (6, 7) applies only to populations which have killed standing trees. No procedure is available for interpreting infestation trends from populations in partially infested standing trees * or infested windthrow.

Living trees were also measured in Becker and Bonito Creeks with the same sampling intensity used in the other drainages during 1971 (3). This green stand data will not be presented here. Rather, all green stand data will be combined to form part of a report now in preparation (1) which evaluates the impact of this infestation on forest resources.

METHODS

The current status of the infestation was evaluated by Region 3 Forest Service Insect and Disease Management personnel during the summer and fall of 1973. The survey covered 18,360 acres in five major drainages of the White Mountains: 2,700 in Becker Creek; 3,740 in Bonito Creek; 4,770 in Ord Creek; 4,340 in Paradise Creek; and 2,810 in Smith Creek.

The survey coordinate lines established during a previous spruce beetle survey (5) were again used. Plots were taken at 5-chain intervals along cruise lines spaced 10 chains apart in Becker and Bonito Creeks, and 20 chains apart in the three other drainages. The variable plot method was used with a 20-basal-area factor in Becker and Bonito Creeks, and a 10-basal-area factor in the other drainages. A Spiegel-Relaskop was employed to measure critical angles from each plot center while automatically correcting for slope. Only standing spruce trees attacked by spruce beetle in 1973 and trees wind-thrown during the last year were counted. The d.b.h. of windthrow was compared with a limiting distance table. Each tree was tallied by 2-inch diameter classes from 6 to 44 inches. The attacked standing trees were further tallied as to whether or not they had been partially infested before. Infested windthrow was also tallied separately from non-infested windthrow.

RESULTS

Engelmann spruce losses totaled about 12,550 standing trees throughout the surveyed drainages: 1,210 trees in Becker; 7,780 trees in Bonito; 2,530 trees in Ord; 950 trees in Paradise; and 80 trees in Smith. Per-acre losses ranged from 0.03 trees in Smith Creek to 2.08 trees in Bonito (Table 1). Tree losses by size class have been presented for each drainage in the Appendix and for all five drainages combined in Table 2. Thirteen percent of all standing trees attacked in 1973 previously had been partially infested.

About 7,000 spruce trees were wind-thrown throughout the surveyed area. Sixty-eight percent of these were infested with spruce beetles (Table 2). Windthrow spruce was most abundant in Paradise Creek, with 0.87 trees per acre, and least abundant in Bonito Creek, with 0.19 trees per acre (Table 1). Most of the windthrow (79%) was smaller than 16 inches d.b.h.

Per-acre basal area and gross volume losses, by cubic and board foot measure, have been presented for standing trees, wind-thrown trees, and total dead trees in Table 1. Bonito Creek had the highest total basal area loss, with 2.3 square feet per acre, and Smith Creek the lowest, with 0.2 square feet per acre. Gross volume losses of wind-thrown trees were highest in Paradise Creek. Overall, 2.8 million board feet of spruce were killed by the spruce beetle in 1973 and 1.3 million board feet of green spruce were lost to windthrow.

Table 1.--Summary of 1973 spruce beetle survey on the Fort Apache Indian Reservation, Arizona.

Drainage	Acres surveyed	1973 Engelmann spruce losses per acre											
		Beetle-infested standing trees				Green wind-thrown trees				Total dead trees			
		No. trees	Basal area[1]	Volume (cu.ft.)	Volume (bd.ft.)	No. trees	Basal area[1]	Volume (cu.ft.)	Volume (bd.ft.)	No. trees	Basal area[1]	Volume (cu.ft.)	Volume (bd.ft.)
Becker	2,700	.45	.8	30.4	161.6	.67	.6	19.6	96.6	1.12	1.4	50.0	258.2
Bonito	3,740	2.08	2.1	71.4	349.2	.19	.2	8.1	40.8	2.27	2.3	79.5	390.0
Ord	4,770	.53	.7	29.4	153.0	.18	.2	10.6	53.6	.71	.9	40.0	206.6
Paradise	4,340	.22	.3	12.5	65.7	.87	.7	25.2	120.1	1.09	1.0	37.7	185.8
Smith	2,810	.03	.1	4.6	26.1	.21	.1	7.1	35.0	.24	.2	11.7	61.1

1/ Square feet.

Table 2.--Combined cruise data for 1973 spruce beetle survey of Becker, Bonito, Ord, Paradise, and Smith Creek drainages - 18,360 acres.

D.b.h. (2-inch classes)	Number of Engelmann spruce trees per acre								
	1973 beetle-infested trees						Non-infested windthrow	Total windthrow	Windthrow percentile
	Fill-in attacks	Initial attacks	Total standing	Standing percentile	Wind-thrown	Total infested			
6	0	.03	.03	4.3	0	.03	.05	.05	13.2
8	0	.10	.10	14.5	.03	.13	.01	.04	10.5
10	0	.12	.12	17.4	.08	.20	.01	.09	23.7
12	.02	.09	.11	15.9	.04	.15	.01	.05	13.2
14	.02	.10	.12	17.4	.05	.17	.02	.07	18.4
16	0	.08	.08	11.6	.02	.10	.01	.03	7.9
18	.01	.04	.05	7.3	.02	.07	0	.02	5.3
20	.02	.03	.05	7.3	.01	.06	.01	.02	5.3
22	.01	.02	.03	4.3	.01	.04	0	.01	2.6
24	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0
30+	0	0	0	0	0	0	0	0	0
Total	.08	.61	.69	100.0	.26	.95	.12	.38	100.1

DISCUSSION

The downward trend in the spruce beetle infestation continued for the third successive year (3, 4). High spruce beetle mortality from sub-zero temperatures early in 1971 apparently initiated the decline (2). In Ord, Paradise, and Smith Creek drainages, only about 3,560 standing trees were attacked in 1973, compared with 7,800 in 1972, 33,000 in 1971, and 22,800 in 1970. Infested trees in Becker and Bonito Creek drainages totaled nearly 8,990 in 1973, compared with 23,540 in 1970. Furthermore, 13 percent of all standing trees attacked in 1973 were already partially infested. It is also likely that many of the remaining trees, initially infested in 1973, will survive. Partially infested trees can be expected to produce fewer beetles than trees killed in one season. In fact, brood production in partially infested trees is often negligible (8). Thus, the infestation appears to be approaching an endemic level throughout most of the survey area.

Less wind-thrown spruce occurred in the survey area in 1973 than in 1972, but the proportion infested by spruce beetle remained high. Approximately one infested windthrow was found on every 4 acres in 1973, compared with almost one per acre in 1972. Although beetle populations in windthrow will undoubtedly influence future standing tree losses, the extent of these losses cannot be predicted at present.

The infestation has reached endemic levels in all parts of the survey area, except possibly Bonito Creek.

RECOMMENDATIONS

Large areas of concentrated green windthrow should be removed where feasible to reduce the potential for beetle population buildup.

The spruce beetle population should be measured in Bonito Creek to estimate the infestation trend there. To do this, standing trees attacked in 1973 should be sampled during late spring of 1974. No sampling should be done in the other drainages, since the infestation there has become endemic.

The status of the Bonito Creek infestation should be evaluated after the 1974 beetle flight. A limited survey should be conducted there in late summer or early fall. The evaluation should include beetle attacks on standing trees, whether attacks are partial or complete, and green windthrow losses.

ACKNOWLEDGMENT

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Appendix Table 1.--Cruise data for 1973 spruce beetle survey of Becker Creek drainage - 2,700 acres.

D.b.h. (2-inch classes)	Number of Engelmann spruce trees per acre					
	1973 beetle-infested trees				Non-infested windthrow	Total windthrow
	Fill-in attacks	Initial attacks	Wind-thrown	Total infested		
6	0	0	0	0	.26	.26
8	0	.14	0	.14	0	0
10	0	0	.09	.09	0	.09
12	0	.06	.06	.12	0	.06
14	0	0	.09	.09	.05	.14
16	0	.07	0	.07	.07	.07
18	0	.05	0	.05	.02	.02
20	0	.02	0	.02	0	0
22	0	.07	.01	.08	0	.01
24	0	0	0	0	.01	.01
26	0	.01	.01	.02	0	.01
28	0	.02	0	.02	0	0
30+	0	.01	0	.01	0	0
Total	0	.45	.26	.71	.41	.67

Appendix Table 2.--Cruise data for 1973 spruce beetle survey of Bonito Creek drainage - 3,740 acres.

D.b.h. (2-inch classes)	Number of Engelmann spruce trees per acre					
	1973 beetle-infested trees				Non-infested windthrow	Total windthrow
	Fill-in attacks	Initial attacks	Wind-thrown	Total infested		
6	0	.12	0	.12	0	0
8	0	.29	0	.29	0	0
10	0	.42	.04	.46	0	.04
12	.07	.22	.03	.32	.06	.09
14	.02	.40	.02	.44	.02	.04
16	0	.16	.01	.17	0	.01
18	.04	.11	.01	.16	0	.01
20	.08	.08	0	.16	0	0
22	.02	.02	0	.03	0	0
24	.02	.01	0	.03	0	0
26	0	0	0	0	0	0
28	0	0	0	0	0	0
30+	0	0	0	0	0	0
Total	.25	1.83	.11	2.18	.08	.19

Appendix Table 3.--Cruise data for 1973 spruce beetle survey of Ord Creek drainage - 4,770 acres.

D.b.h. (2-inch classes)	Number of Engelmann spruce trees per acre					
	1973 beetle-infested trees				Non-infested windthrow	Total windthrow
	Fill-in attacks	Initial attacks	Wind-thrown	Total infested		
8	0	.06	0	.06	0	0
10	0	.08	0	.08	0	0
12	.03	.05	.02	.10	0	.02
14	.02	.04	.04	.10	0	.04
16	.02	.06	.01	.09	.02	.03
18	.03	.02	.05	.10	0	.05
20	.01	.05	.03	.09	.01	.04
22	.01	.03	0	.04	0	0
24	0	0	0	0	0	0
26	0	0	0	0	0	0
28	.01	0	0	.01	0	0
30+	0	.01	0	.01	0	0
Total	.13	.40	.15	.68	.03	.18

Appendix Table 4.--Cruise data for 1973 spruce beetle survey of Paradise Creek drainage - 4,340 acres.

D.b.h. (2-inch classes)	Number of Engelmann spruce trees per acre					
	1973 beetle-infested trees				Non-infested windthrow	Total windthrow
	Fill-in attacks	Initial attacks	Wind-thrown	Total infested		
6	0	0	0	0	.12	.12
8	0	0	.13	.13	.07	.20
10	0	0	.17	.17	.05	.22
12	0	.09	.09	.18	0	.09
14	.02	.02	.09	.13	.02	.11
16	0	.06	.06	.12	0	.06
18	0	.01	.02	.03	0	.02
20	0	0	.01	.01	0	.01
22	.01	0	.03	.04	0	.03
24	0	0	0	0	.01	.01
26	0	0	0	0	0	0
28	0	.01	0	.01	0	0
30+	0	0	0	0	0	0
Total	.03	.19	.60	.82	.27	.87

Appendix Table 5.--Cruise data for 1973 spruce beetle survey of Smith Creek drainage - 2,810 acres.

D.b.h. (2-inch classes)	Number of Engelmann spruce trees per acre					
	1973 beetle-infested trees				Non-infested windthrow	Total windthrow
	Fill-in attacks	Initial attacks	Wind-thrown	Total infested		
10	0	0	.13	.13	0	.13
12	0	0	0	0	0	0
14	0	0	0	0	.03	.03
16	0	0	.02	.02	0	.02
18	0	0	.02	.02	0	.02
20	0	0	0	0	0	0
22	.01	0	.01	.02	0	.01
24	0	0	0	0	0	0
26	.02	0	0	.02	0	0
28	0	0	0	0	0	0
30+	0	0	0	0	0	0
Total	.03	0	.18	.21	.03	.21